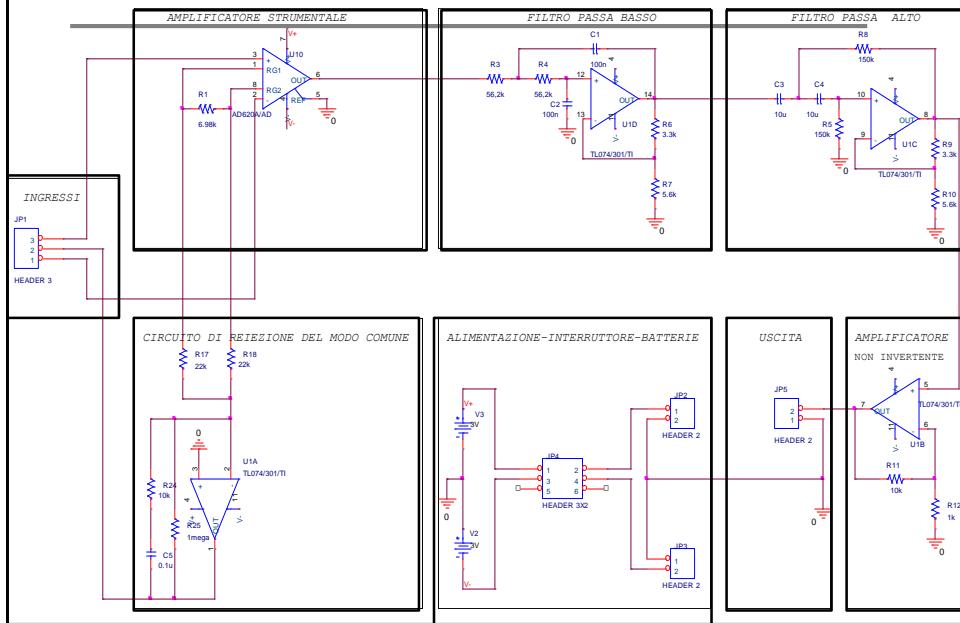
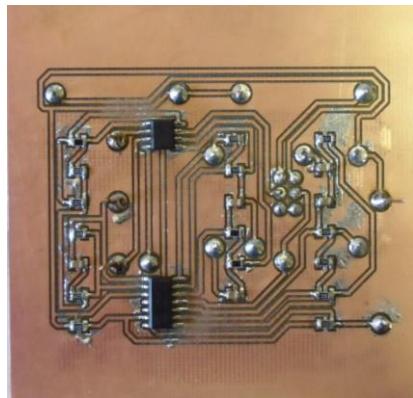


Elettrocardiografo

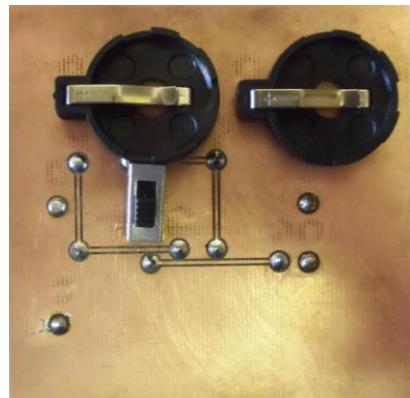
SCHEMATICO DEL CIRCUITO



REALIZZAZIONE CIRCUITO STAMPATO

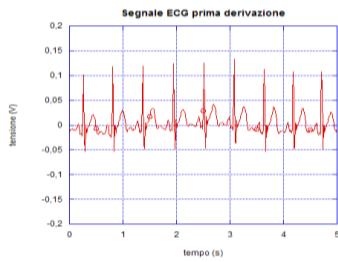


*Circuito stampato
Layer Top*

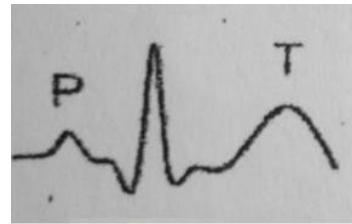


*Circuito stampato
Layer Bottom*

MISURE EFFETTUATE SUL CIRCUITO CON ACQUISIZIONE SU LabVIEW



Acquisizione della I derivazione con passa banda(0,1-30 Hz)



Forma d'onda ideale della I derivazione

Sistemi wireless

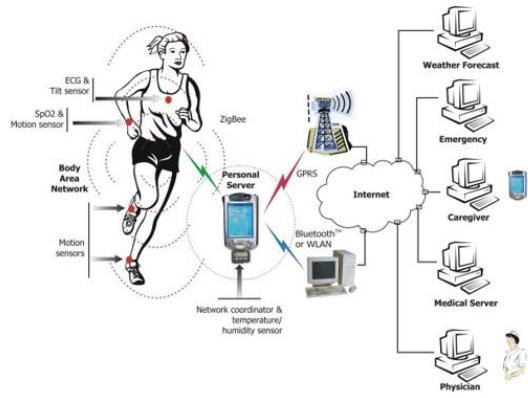


Figura 1 – Rete di sensori per il monitoraggio degli atleti durante l'attività sportiva [2].

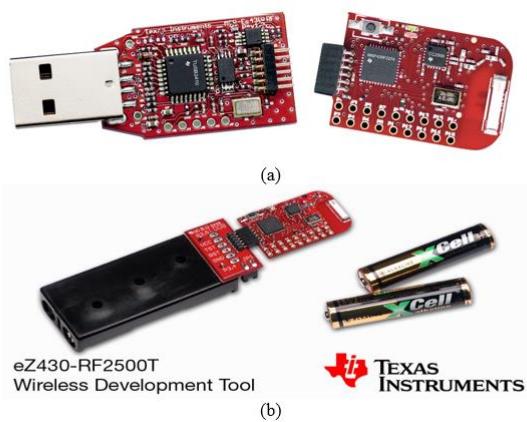


Figura 3 – Foto dell'eZ430-RF2500: access point (a) e end device (b).

Schede Raspberry Pi

Single-board computer

• Raspberry Pi 0 W

- SoC Broadcom BCM2835:
- ARM 1 GHz, 32-bit single-core
- GPU: (1080p60)
- Ram: 512 MB (condivisa con la GPU)
- MicroUSB e Mini HDMI
- Wi-Fi e Bluetooth 4.1
- 40 porte GPIO (UART, SPI, I₂C)
- OS Raspbian



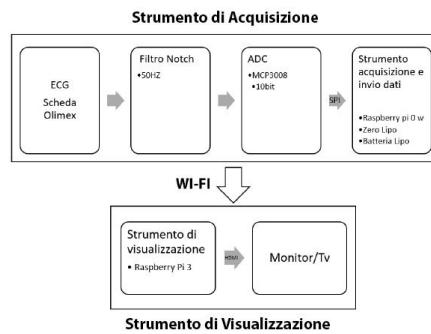
• Raspberry Pi 3

- SoC Broadcom BCM2837:
- ARM 1.2GHz, 64-bit quad-core
- GPU: (1080p60)
- Ram: 1GB (condivisa con la GPU)
- 4 USB, HDMI, Ethernet
- Wi-Fi e Bluetooth 4.1
- 40 porte GPIO (UART, SPI, I₂C)
- OS Raspbian



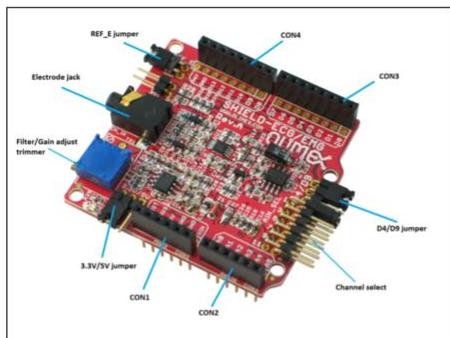
Presentazione progetto

Il progetto si prefissa l'acquisizione e la visualizzazione del segnale ECG su una TV domestica utilizzando schede Raspberry Pi e Wi-Fi

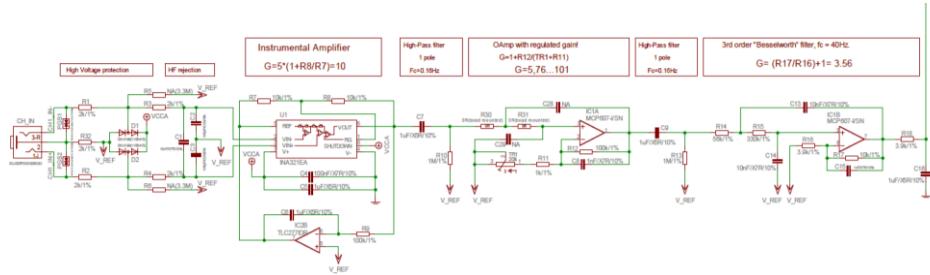


Strumento di Acquisizione: Scheda Olimex

Per misurare l'ECG utilizziamo la scheda progettata dalla Olimex insieme al cavo in dotazione



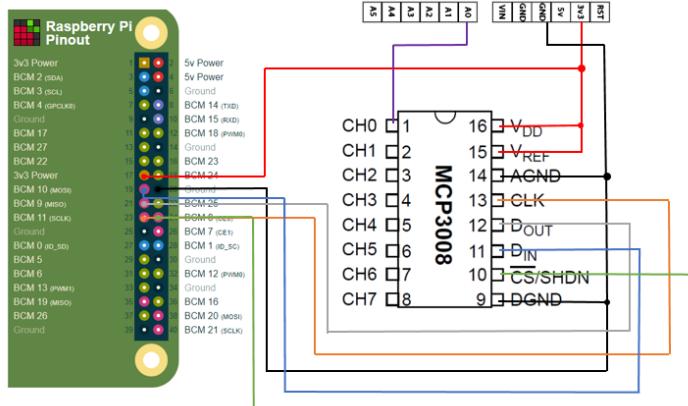
Schema circuitale Olimex



Collegamento Schede: ADC MCP3008

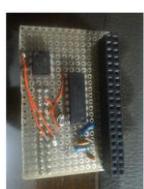
MCP3080:

- SPI
- 10bit
- 8 canali

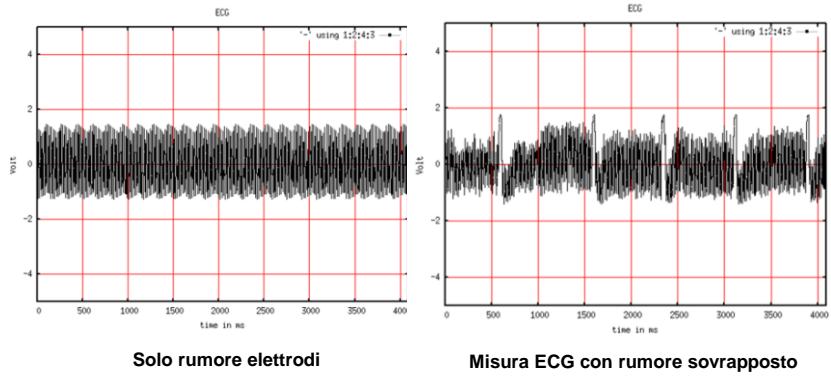


Collegamento Schede: Shield

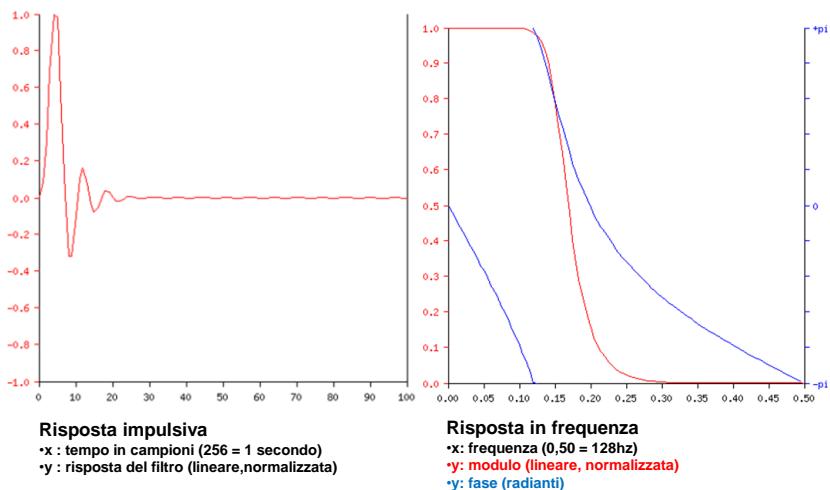
Abbiamo realizzato su una mille fori una scheda di interfaccia con convertitore MCP3008 e Filtro Notch



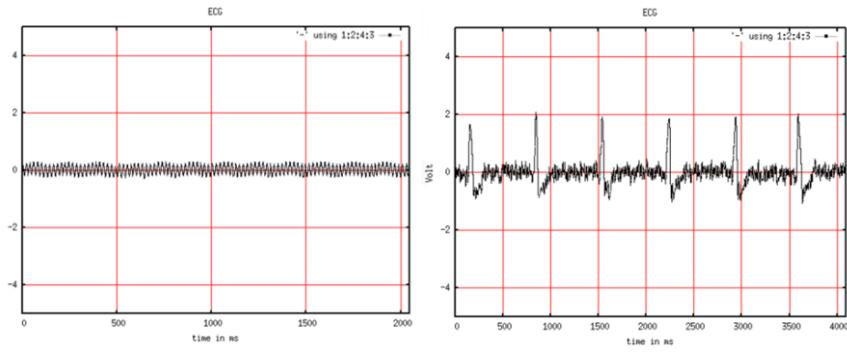
Visualizzazione ECG con la sola scheda Olimex:



Inserimento filtro informatico: Butterworth sesto ordine



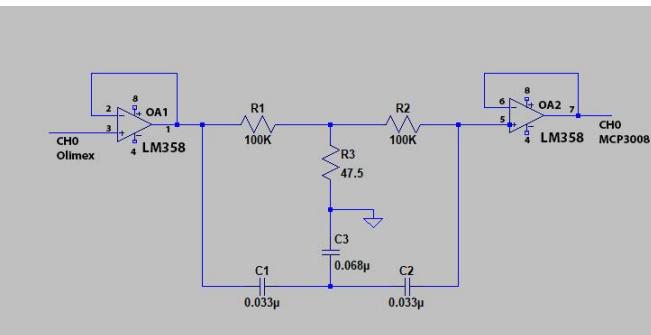
Visualizzazione ECG con filtro Butterworth



Solo rumore elettrodi

Misura ECG con rumore sovrapposto

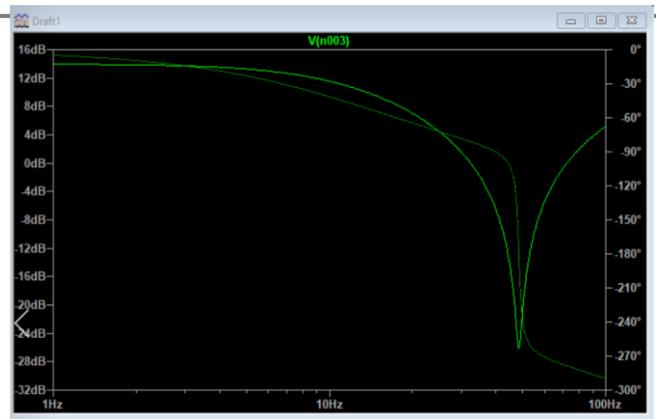
Filtro notch 50Hz: Schema circuitale



LM358:

- Due amplificatori operazionali
- Alimentazione singola (5v-GND)

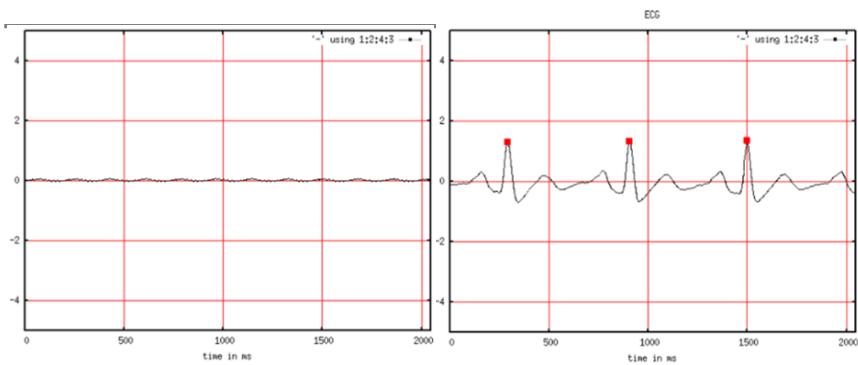
Filtro notch 50Hz: Modulo e Fase



Asse y sinistro: Modulo (dB)
Asse y destro: Fase (Gradi)
Asse x: Frequenza(Hz)

Funzione continua Modulo
Funzione punteggiata Fase

Misura finale ECG con filtri



Rumore elettrodi

Misura ECG

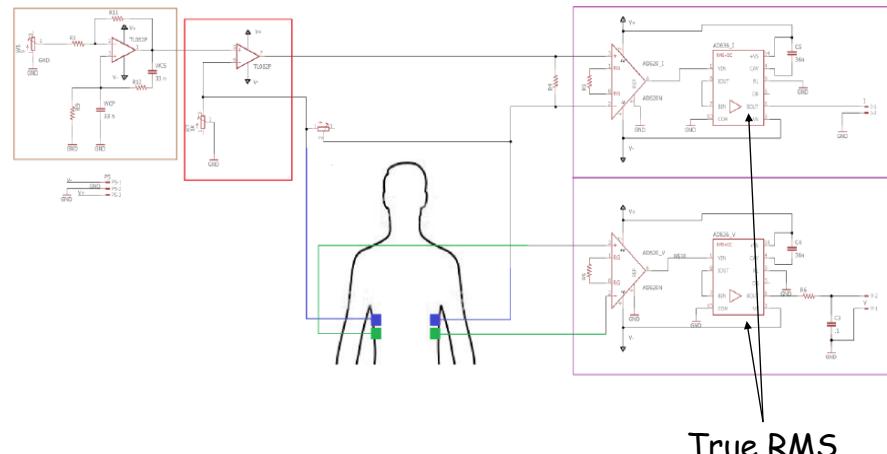
Schermata TV



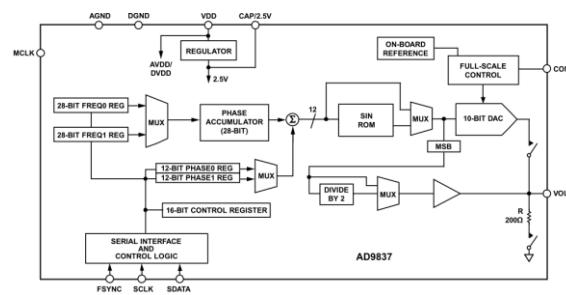
Interfaccia grafia Pixel Raspbian con ECG su TV

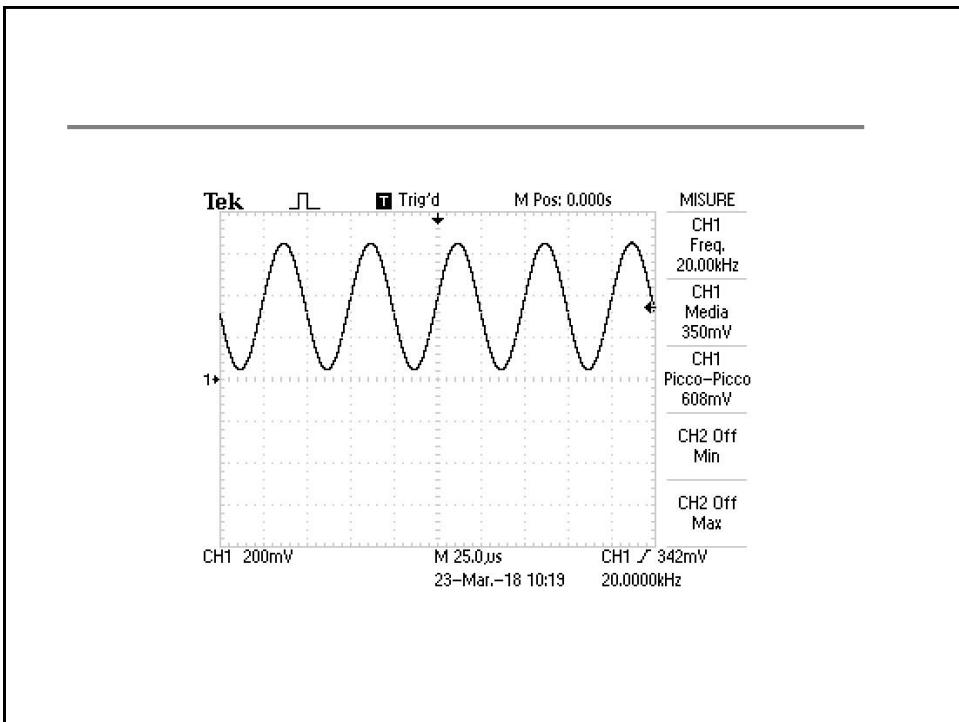
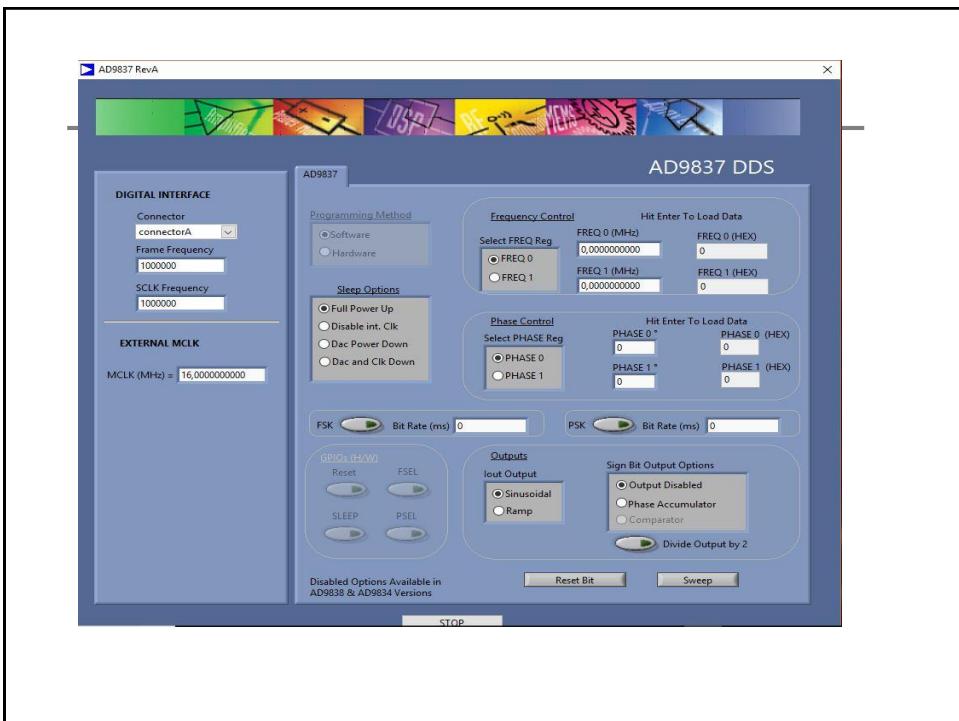
Impedenziometro

Misura a 4 elettrodi

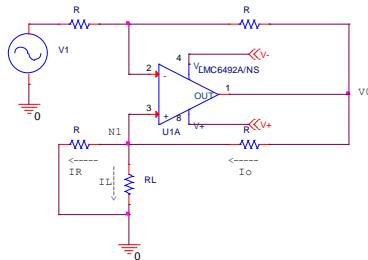


AD9837 DDS

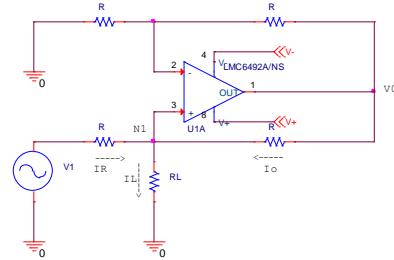




Howland Pump

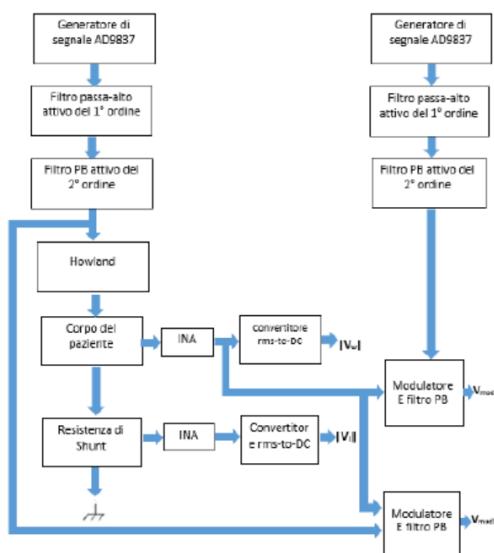


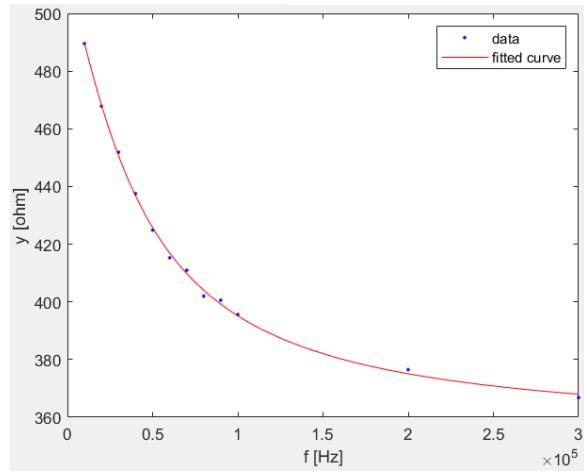
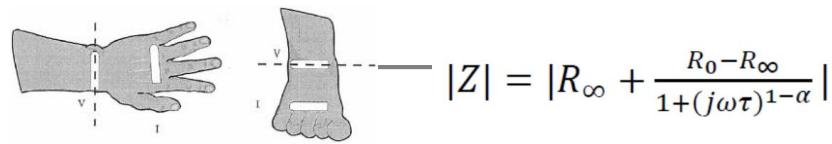
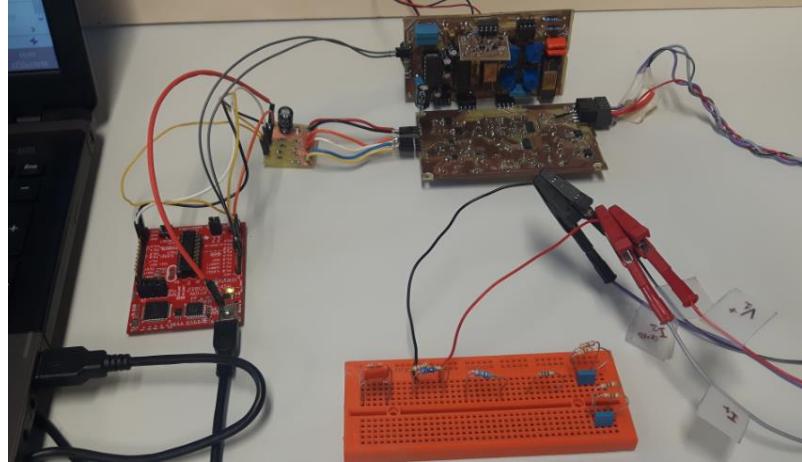
INVERTENTE



NON INVERTENTE

Impedenziometro multifrequenza





Correzione artefatti

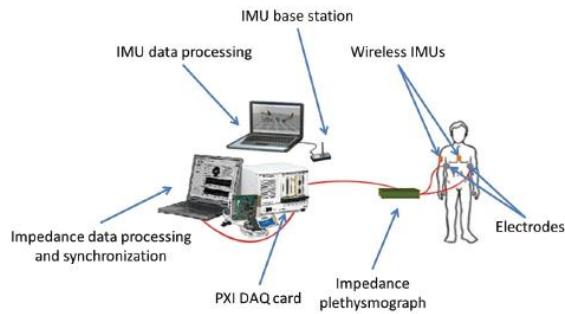
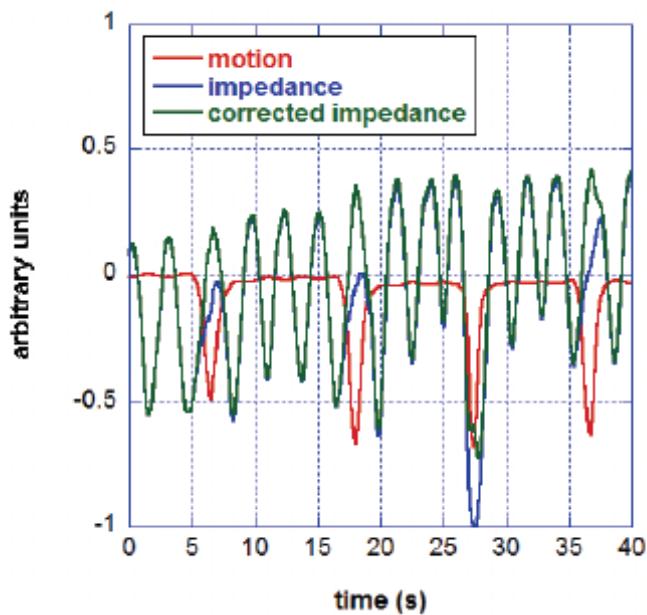
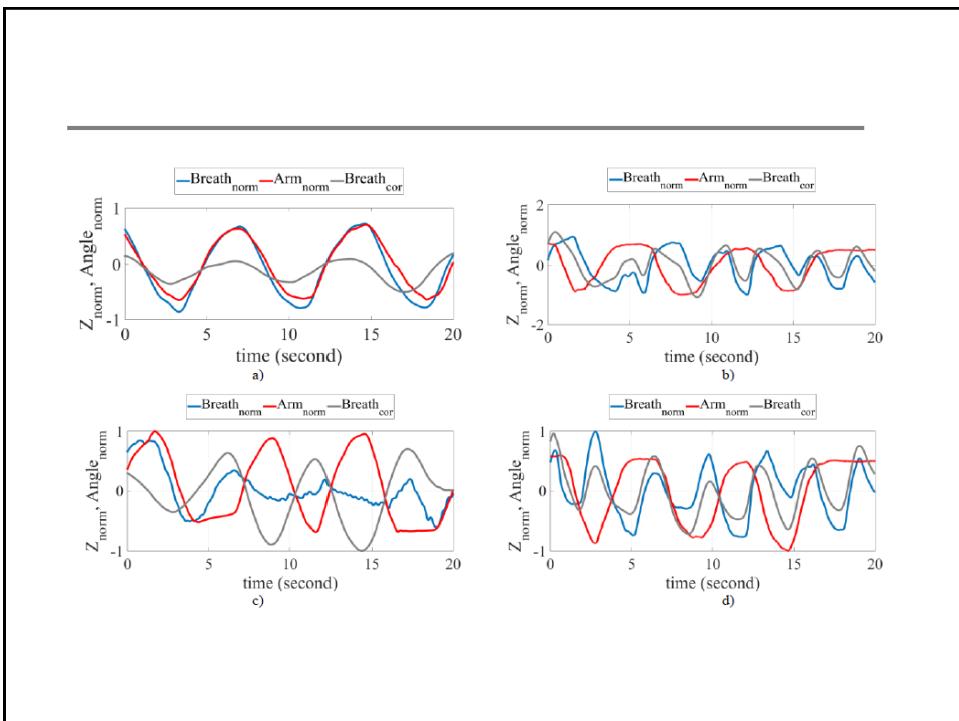


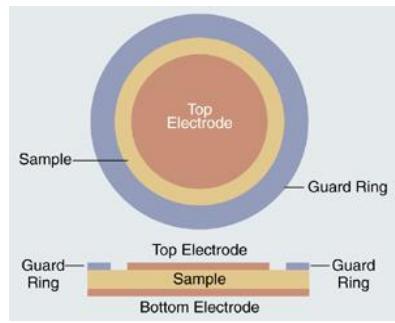
Fig. 1. Experimental set-up.

wireless inertial measurement units - IMUs - (Xsens MTw development kit) attached to the body by click-in straps.





Gli elettrodi con anello di guardia: Generalità



si mantengono equipotenziali sfruttando la massa
virtuale di un amplificatore operazionale

Realizzazione (7): L'anello di guardia

Il Test alternativo della sua efficienza



Test dello strumento: Test dell'anello di guardia

Acqua normale



Caso 'singolo elettrodo' - $R = 3530 \Omega$

Acqua salata



$R = 810 \Omega$

Caso 'coppia cortocircuitata' - $R = 3000 \Omega$

$R = 683 \Omega$

Caso 'anello di guardia' - $R = 9320 \Omega$

$R = 2600 \Omega$

Pulsossimetro

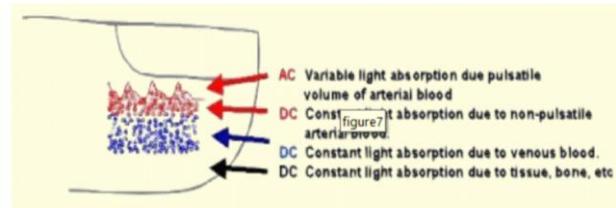
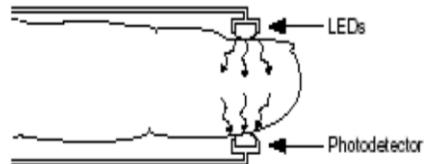
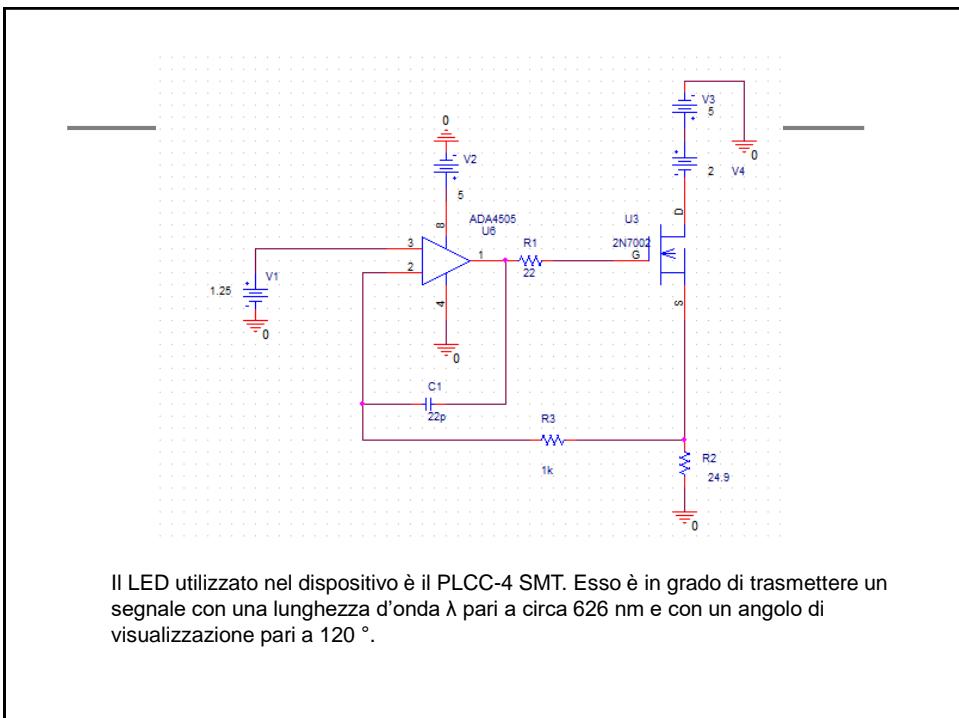
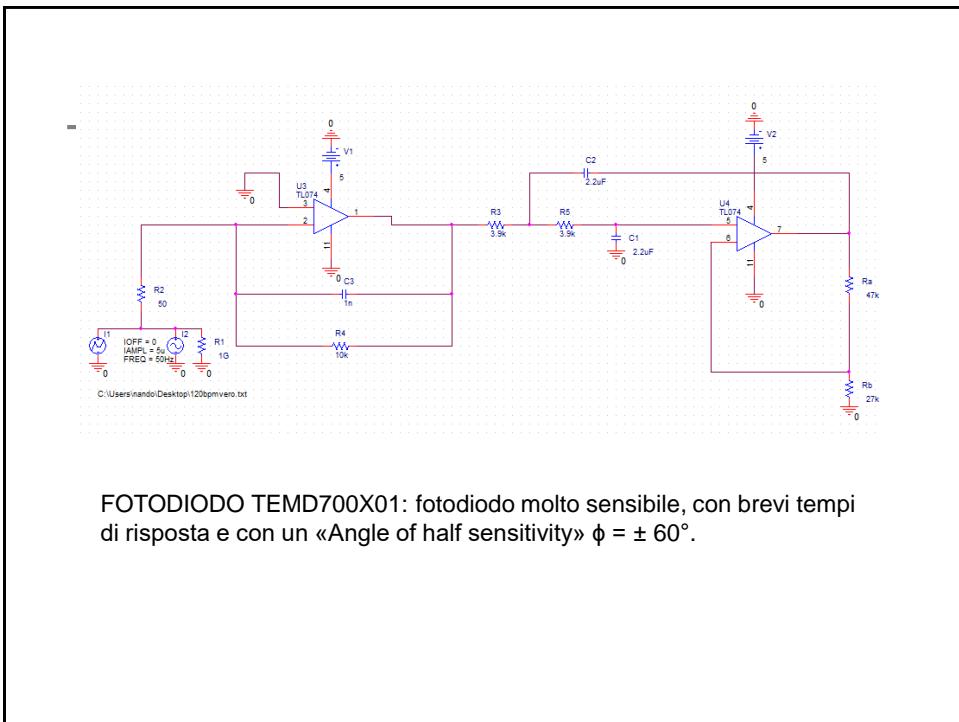


Figura 6 - Zone di assorbimento della luce



Il LED utilizzato nel dispositivo è il PLCC-4 SMT. Esso è in grado di trasmettere un segnale con una lunghezza d'onda λ pari a circa 626 nm e con un angolo di visualizzazione pari a 120 °.



FOTODIODO TEMD700X01: fotodiodo molto sensibile, con brevi tempi di risposta e con un «Angle of half sensitivity» $\phi = \pm 60^\circ$.

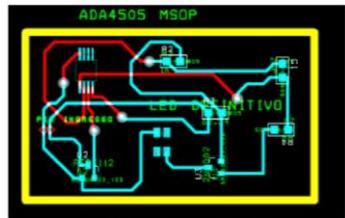


Figura 51 - Layout finale per il circuito controllante il Led

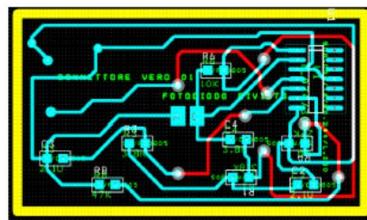


Figura 57 - Layout Finale

AFE4490 TEXAS INSTRUMENTS PULSOSSIMETRO



AFE4404EVM Scheda di Valutazione pulsossimetro

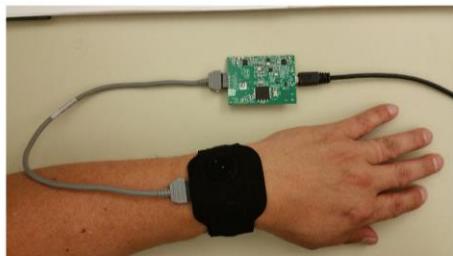


Figure 3. Setup for Obtaining Measurements from the Wrist
Note: Figure 4 through Figure 7 help get to Figure 3.

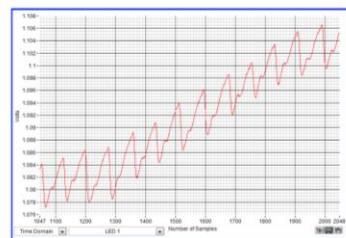


Figure 8. Sample Waveform of Green LED Captured on the Wrist With NJRC NJL5513R

*Corso di Strumentazione e
tecniche per la diagnostica*

Tomografia di Impedenza

Sheffield

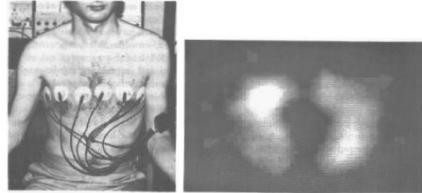


Figure 4. (a) Electrodes placed around the thorax in order to produce impedance images of the changes in lung resistivity during respiration. (b) An EIT image obtained using 16 electrodes placed around the thorax. The lungs are well resolved in this image which shows the increase in resistivity on inspiration. Anterior is at the bottom and the left side of the trunk on the right of the image.



**Dispositivo commerciale
Sheffield Mark 3.5
Maltron**

Sheffield Mk1 (Barber e Brown Uni. Sheffield 1984)

Drager

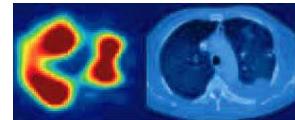


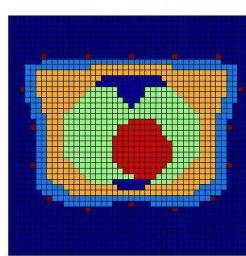
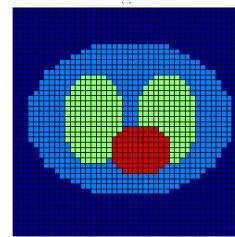
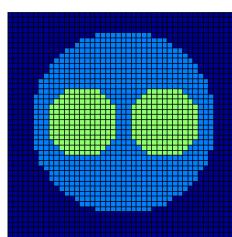
Fig. 5. Simultaneous EIT image (left) and CT scan from a patient with a pleural effusion after rupture of a pulmonary vein, resulting in a significantly reduced ventilation of the lower left lung. The red color represents regions with the highest volume changes, the nonventilated regions are displayed in deep blue.

Drager Medical - 2008

PULMOVISTA 500



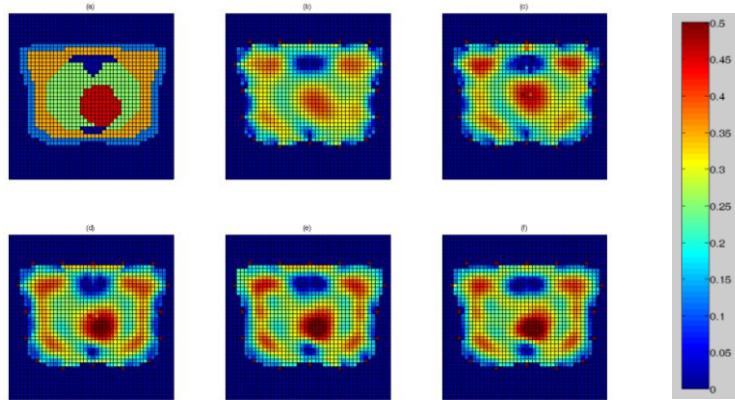
MODELLI DEL TORACE



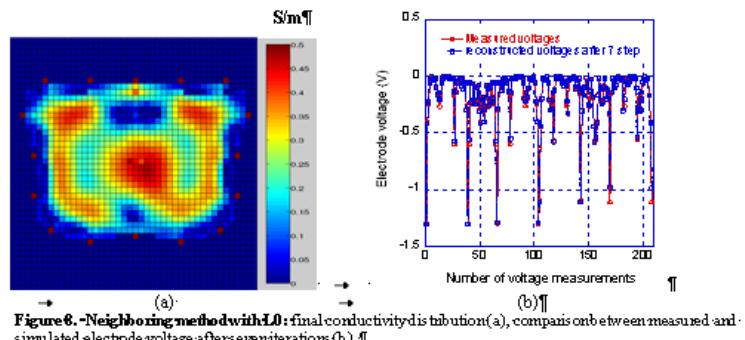
Modello VH

- Polmone 0.25 S/m
- Cuore 0.45 S/m
- Muscoli 0.35 S/m
- Ossa 0.02 S/m
- Pelle/grasso 0.03 S/m

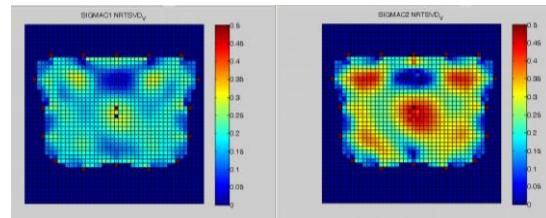
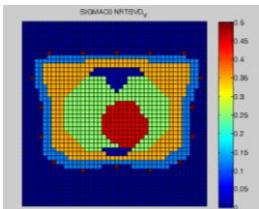
Ricostruzioni con varie tecniche



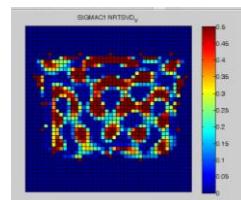
(a) Distribuzione originale; (b) ricostruzione con matrice di regolarizzazione nulla e $J=S$;
 (c) ricostruzione con matrice di regolarizzazione nulla e J calcolata da Y ,
 (d) $L =$ matrice identità, (e) $L =$ versione discreta dell'operatore gradiente,
 (f) $L =$ versione discreta dell'operatore Laplaciano.



Effetto della tolleranza della TSVD

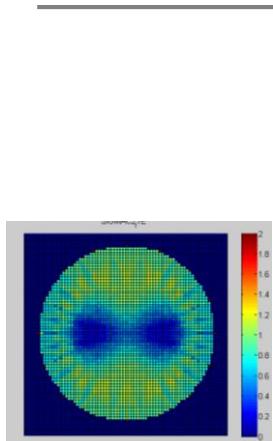


Tol $4.0e-4$ - 58 valori singolari

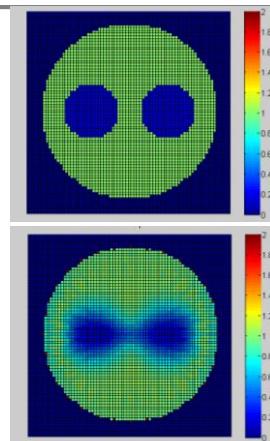


Tol $4.0e-8$ - 95 valori singolari

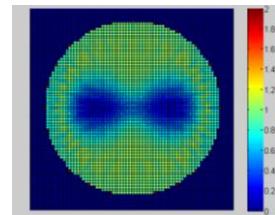
Effetto numero elettrodi



16 elettrodi
EM=6.64

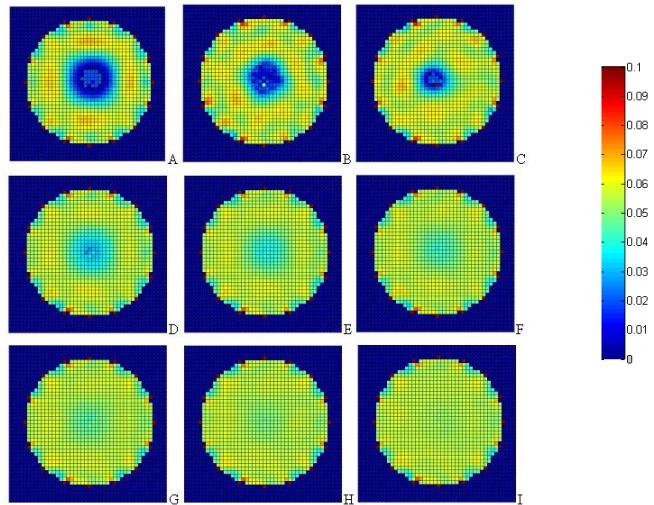


24 elettrodi
EM=4.37



32 elettrodi
EM=3.99

Risoluzione spaziale



Confronto FEM - FD (Ammettenze)

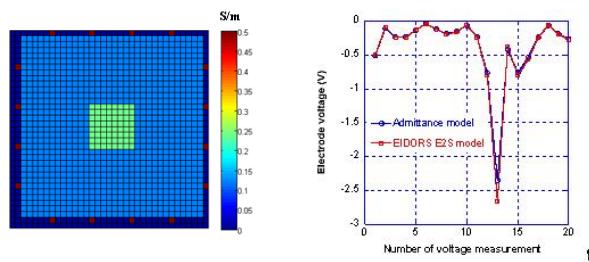


Figure 4: Electrode voltages for the square geometry with square anomaly by using the FD method and the FEM method implemented in EIDORS [1].

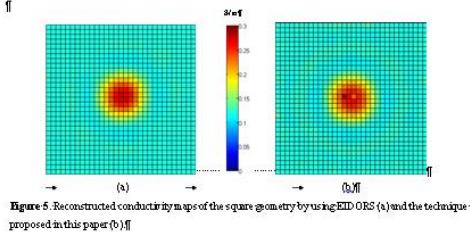
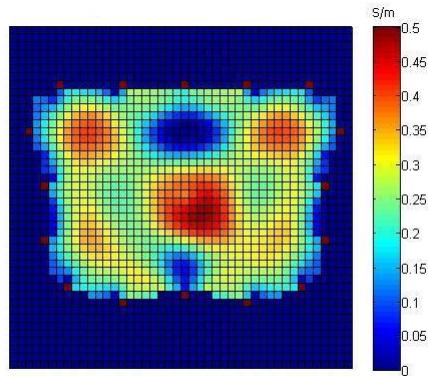
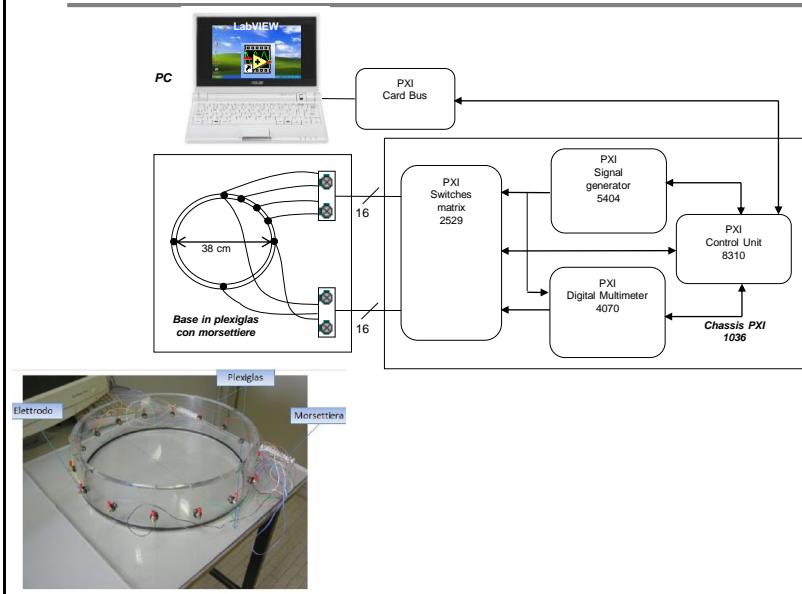


Figure 5: Reconstructed conductivity maps of the square geometry by using EIDORS (a) and the technique proposed in this paper (b).

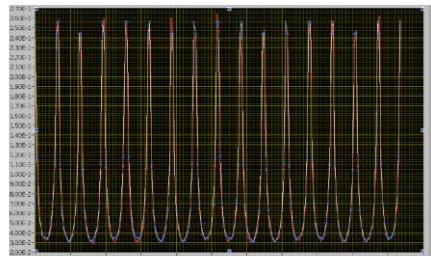
....e in un ciclo respiratorio completo



Sistema Sperimentale



Uniform Phantom ($\sigma = 0.0564 \text{ S/m}$)

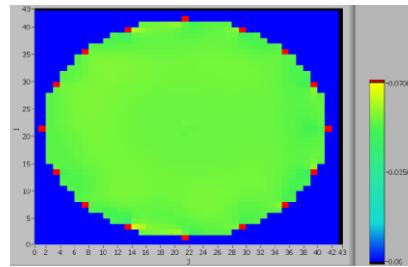


208 acquired
experimental voltages
(blue points)
and simulated voltages
(red points)

error function

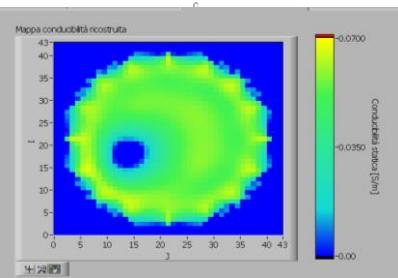
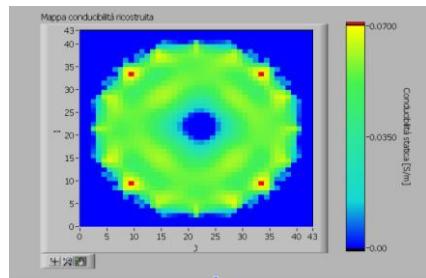
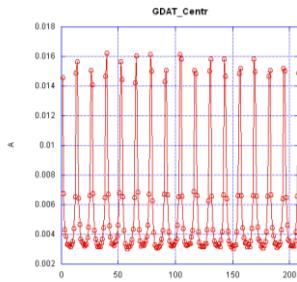
$$E = \frac{\left[\mathbf{g}^{rec}(c) - \mathbf{g}^{meas} \right]^T \cdot \left[\mathbf{g}^{rec}(c) - \mathbf{g}^{meas} \right]}{\left(\mathbf{g}^{meas} \right)^T \cdot \mathbf{g}^{meas}} \times 100$$

$$\sigma = 0.0564 \text{ S/m} \quad E = 0.28 \%$$

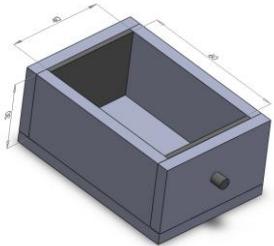


reconstructed conductivity image

Sistema sperimentale (cilindri dielettrici)



Phantom Materials



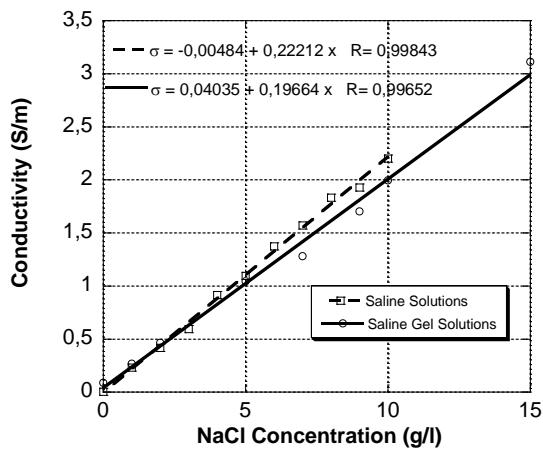
saline solutions are prepared by adding various concentrations of sodium chloride (FU-Ph.Eur) to deionised water at room temperature

saline gels are prepared by adding agar gel (Agar-Agar E406, powder) to saline solutions while the water is heated to 85 °C and stirred vigorously

The solution is then put inside the test cell to cool to room temperature and finally the resistance measurements are performed.

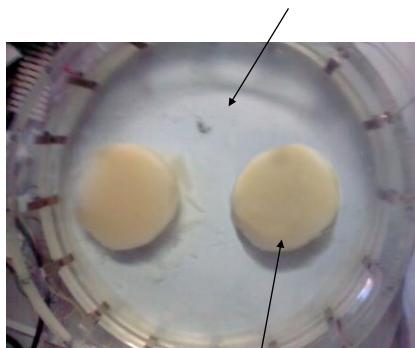
$$\sigma = \frac{1}{R_M} \cdot \frac{l}{S} = \frac{50}{R_M} \quad [S/m]$$

Conductivity of the saline and saline gel solutions as a function of the salt concentration

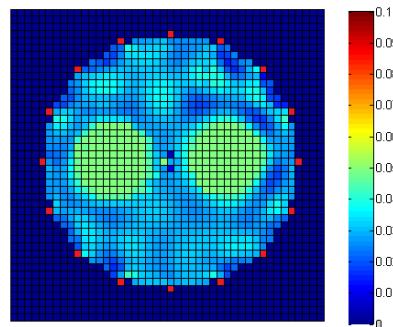


Two Cylinder Phantom

Deionised Water $\rightarrow \sigma \approx 0 \text{ S/m}$



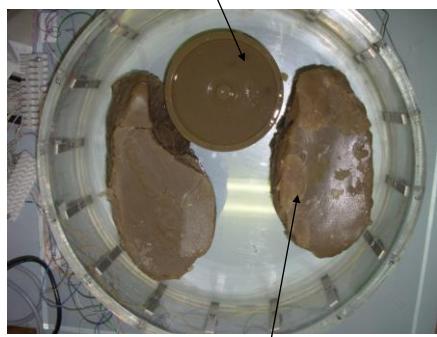
cylinder $\rightarrow \sigma = 0.05 \text{ S/m}$



Reconstructed image

Realistic Geometry

heart



lung

